haunts. A single fine ♂ *Polyommatus hylas* was the only representative here of this beautiful species. Swarms of *Eubolia mensuraria* moved from place to place as one forced one's way through the long herbage, whilst *Dasydia obfuscata* was in smaller numbers. *Acidalia perochraria* occurred frequently on the bank and one or two *Acidalia fumata* were disturbed; *Scopula alpinalis* ab. *punctata* (with white discal spot on the wings) was stirred up, as were *Crambus pratellus*, *C. dumetellus*, and *C. falsellus*, whilst *Phycis* (?) *adornatella* was also disturbed. Among the plumes, *Stenoptilia pterodactyla* and *Merrifieldia tridactyla* (*tetradactyla*) were very abundant, as were also one or two other species of which we do not seem to have retained a sample. Heaps of other interesting species were seen on this bank, but we had been already here more than two hours and the clouds appeared to be gathering. No sooner were we off the bank than the sun disappeared, but, hoping that it would not rain, we started up the narrow valley. We disturbed nothing fresh that we had not seen on the bank till we had got a considerable distance up the valley, when, in the corner of a field, we noticed at rest a fine example of *Cyclopides palaemon*, and soon afterwards netted two others, during a gleam of sunshine, on the wing, and a fourth at rest, but, with the exception of the first example, none were really good. We continued our walk up the valley, examined the lovely mosses, whilst the sky grew ever more and more threatening. Soon the rain began to descend, and before long we were driven back. The climbers ran by us at full pelt, and, knowing the appearance of the sky, showed their wisdom in their haste; having made little or no preparation against the weather we had to shelter and push on between the worst parts of the storm, but arrived at St. Anton sufficiently wet to require a thorough change. It continued to rain all that day and night, and all next day, during which we moved on to Innsbruck. It rained all the 4th, and, on the morning of the 5th, so, as the Meteorological Chart in the Maria-Theresien-Strasse had registered "Botzen, schön," for some days, whilst all the rest of the world was wet, I set my nose in the direction of Botzen, by way of the Brenner Pass.

Summary of experiments with fertile ♀ s of several species of ants.

By C. CRAWLEY, B.A., F.E.S.

1. Camponotus ligniperdus.—In June, 1905, I found an apterous ♀ of this species on a road near Ouchy, Switzerland. On June 16th I put her in a box with three ☿ s of the same species, who immediately attacked her. I removed the ☿ s, and next day put three more from another nest with the ♀. They were not so hostile as the first ones, but seemed frightened of the ♀, and avoided her.

2. Formica rufa.—During August and September, 1904, I had a nest of *F. rufa* containing one ♀. On August 7th I put a strange fertile ♀ into my nest. The ants took very little notice of her, and she seemed quite at home among them. I then procured another ♀ from a different nest, and put her into my nest on August 16th, with a similar result. Two days later I put in a third, from another nest, with a similar result.

3. Formica sanguinea.—On September 13th, 1908, I put several ☿ s from different nests of this species at Wellington College with a young fertile ♀ that I had picked up in the neighbourhood. They

were all hostile to her. I then put her with a number of pupæ and a few newly-hatched ☿ s, not yet fully-coloured, from a nest I had under observation. I found these immature ☿ s indifferent to the ♀, though the full-coloured ones were hostile. The ♀ assisted the pupæ to hatch, thus forming a small nest. On September 17th I introduced some ☿ s from the parent nest into this small one. They very soon found the ♀ and attacked her, so that I had to take them out of the nest and separate them. I then put in a *F. fusca* slave from the parent nest. This *F. fusca*, though friendly to the ☿ s, as were the ☿ s from the parent nest, attacked the ♀ viciously. Eventually the *F. sanguinea* ♀, during the struggle, caught the *F. fusca* by the back of the thorax, killing the ant with a single bite. On October 2nd I again introduced a ☿ from the old nest. It found and attacked the ♀ immediately. I put no more in till March, 1909, when I put in two ☿ s on the 12th. I watched carefully, but could see no signs of fighting. On March 17th and 18th I put in two more, and on the 19th, 20th, and 21st put in two each day. There was no fighting at all, so at 12.45 p.m. on March 21st I placed the two nests about four inches apart and opened the entrances. On returning at 2.10 p.m. I found the ♀ transferred from the new nest to the old, and the ☿ s from the latter were engaged in carrying the workers from the new nest to their own. The two nests became one, which is still in existence (January, 1910). During 1909 the ♀ laid a number of eggs, all of which were devoured by the ☿ s. In a nest of *F. sanguinea* and *F. fusca* with no ♀, a number of eggs were laid by the *F. sanguinea* and *F. fusca* ☿ s during 1904, but all were eaten. On July 19th, 1903, I put a number of *F. fusca* pupæ (both ☿ and ♀) and larvæ outside a small observation nest of *F. sanguinea*. The *F. sanguinea* carried in the larvæ and pupæ, killing a few ☿ s that were among them. About the same time I put in a fertile *F. fusca* ♀, which they killed. Some of these *F. fusca* larvæ were eaten by the ants, but others became pupæ.

On September 18th, after having been away for a fortnight, I found most of the *F. fusca* pupæ had hatched, and there were in the nest a *F. fusca* ♀ with one wing, another with only the two lower wings, and two ♀ s without wings. There had been no ♂ s in the nest, and these ♀ s were not fertile. During the autumn of 1903 and the winter the examples of *F. fusca* in this nest (they outnumbered the *F. sanguinea*) were continually being pulled about by the *F. sanguinea*, two or three of the latter often attacking one *F. fusca*. The larger *F. fusca* ☿ s and the ♀ s seemed to be chiefly molested. One of the ♀ s died during September, and another on October 14th, both having been attacked by *F. sanguinea* and *F. fusca* ☿ s. The headless body of the third was found outside the nest on May 4th, 1904, but the fourth lived till June 20th. This same nest of *F. sanguinea* was doubled in size by the addition of ☿ s from two nests at Wellington College. At first they seemed inclined to fight with the original occupants, but in a few hours they voluntarily entered the nest and joined forces with the others (August 16th, 1904). I gave the nest a number of *F. rufa* pupæ, which they readily carried in. On September 9th, when there was a large number of *F. rufa* ☿ s in the nest, I put a fertile *F. rufa* ♀ to the door of the nest. She entered without hesitation, and was unnoticed by the *F. sanguinea* and *F. rufa*, but two *F. fusca* attacked her violently, and later a *F. sanguinea* and a *F. fusca*. The following day she was

still alive, but some *F. sanguinea* and a *F. fusca* were pulling her about the nest. On the morning of September 11th she was dead. The same evening I put another *F. rufa* ♀ about six inches from the nest. After a moment's hesitation she went straight to the door and inside. A *F. rufa* pulled her by a mandible for a moment, but she was otherwise unmolested. Next morning I found her outside the nest, quite unhurt, being dragged about by a *F. fusca*. On April 21st, 1909, I put a fertile *F. fusca* ♀ into a nest of *F. sanguinea* which only contained two *F. fusca* ☿ s. The *F. sanguinea* made some show of attacking her, but she was allowed to escape unhurt.

4. Formica fusca.—I made several experiments with fertile ♀ s of this species, and nests both with and without queens. All these experiments resulted in the strange ♀ s being attacked, but unfortunately I omitted to record most of these cases. On April 18th, 1909, I tried a fertile *F. fusca* ♀ with some workers of the var. *rufibarbis*. They attacked her. On the 21st I put her in an observation nest of *F. fusca* which contained one ♀. These ants also attacked her. Again, May 22nd, I put the same ♀ with a few ☿ s and a ♀ of the same species. The strange ♀ was found dead next day. A rather unusual case occurred last year. In a small plaster nest I had a *F. fusca* ♀ with one ☿. I put a ☿ of *F. subserica* (?) from America in this nest on October 6th, 1909. The solitary ☿ immediately began to fight with her, but after a few minutes they stopped. Next day there was one of the ☿ s dead, probably the *F. fusca*. The *F. subserica* ☿ seemed perfectly friendly with the ♀, so on October 9th I put the remaining thirteen *F. subserica* with them. They were all friendly with the ♀, and, at the present moment (January, 1910), there still remain ten *F. subserica* ☿ s and the *F. fusca* ♀.

5. Lasius flavus.—Besides several unrecorded failures to induce nests of this species to accept strange ♀ s, I have noted the following:—August, 1893, I introduced a fertile ♀ to a queenless nest of the same species; the ants attacked her and penned her in with earth in a corner. August 6th, 1897, I put into a queenless nest of *L. flavus* a fertile ♀ that I had kept alone since the previous summer. She entered the nest readily and was soon surrounded by ants, who saluted her as they do their own queen. Only one ant attacked her for a moment, and she was accepted as queen. On January 14th, 1910, I put an old fertile ♀ of *L. flavus* into a queenless nest of the same species. Very little notice was taken of her, and she was soon attacked by several ants. All the apterous ♀ s of *L. flavus* that I have captured immediately after swarming, have laid eggs a few days afterwards. I have found this species very hostile to ♀ s of *L. niger* (January 14th, 1910, and other occasions), and *L. umbratus* (September 18th, 1909, and other occasions).

6. Lasius niger.—In August, 1895, I took part of a nest of this ant and established it with its queen in a Lubbock nest. Wishing to possess the whole colony, a few days later I again dug up this nest and found another queen, which I put in my nest. The ☿ s were perfectly friendly, but a few hours afterwards they dragged her out of the nest and left her. Workers from the old nest were readily received in my nest. On August 13th, 1898, I introduced some ☿ s from a nest of *L. niger* (containing a ♀ *L. umbratus* as queen) to a fertile ♀ of their own species. The following day, when these ☿ s were on friendly

terms with the ♀, I put them all into the nest. The ♀ was at once attacked, and a few hours later was dead. On January 9th, 1910, I put a fertile ♀ of an American variety of *L. niger* in a nest of the same species which contained a ♀. The strange ♀ avoided every ant she met, and was very soon attacked. Two queenless nests of *L. niger* accepted fertile ♀s of *L. umbratus* (August 24th, 1896, and September 19th, 1908), as already recorded (*Science Gossip*, May, 1900, and *The Entomologist's Monthly Magazine*, April and May, 1909). *Lasius flavus* ♀s were always attacked by *L. niger* (January 14th, 1910, and other cases not recorded). Isolated ♀s of *L. niger* kept by me have always laid eggs shortly after swarming (September 12th, 1904, and other cases), except two ♀s of an American variety of *L. niger*, 1909, whereas ♀s of *L. umbratus* have never begun to lay till the year after fertilisation (the two cases of *L. umbratus* ♀s and *L. niger* above mentioned, 1896 and 1908, and solitary *L. umbratus* ♀s in 1895, 1896, 1899, and 1909).

7. Hostility to strange ♀s.—I have found *Myrmica ruginodis*, *M. laevinodis*, and *M. scabrinodis* invariably hostile to strange ♀s. The only case recorded was on May 18th, 1909, when I put a strange *M. laevinodis* ♀ into a nest of the same species. She was at once attacked and dragged out of the nest. I put her in again later, and she was again dragged out, one ☿ trying to sting her.

8. Embryo nests.—With regard to embryo nests, I have found what seemed to be the beginnings of nests among the following species only:—

(*a*) *Lasius niger*.—One solitary ♀ in sand at Wellington College, April 13th, 1903; a ♀ with larvæ under a stone at Ouchy, Switzerland, June 7th, 1905; and two ♀s alone under a stone, Cleveland, U.S.A., September 18th, 1909.

(*b*) *L. flavus*.—Four ♀s together under a stone (probably only a temporary retreat), August 6th, 1904; and a single ♀ in a small chamber in the earth under a stone (date not recorded).

(*c*) *L. umbratus*.—A ♀ under a stone with two ☿s, March 23rd, 1903.

(*d*) *Myrmica ruginodis*.—A solitary ♀ in the ground, April 18th, 1909.

(*e*) *Leptothorax tuberum*, race *nylanderi*.—A ♀, one ☿, and three larvæ, inside a beech-nut, at Pangbourne, Berks, September 24th, 1903.

9. Lasius fuliginosus.—At Ouchy, Switzerland, June 15th, 1905, I saw ☿s of *L. fuliginosus* pulling apterous ♀s after swarming into their nest. The ♀s apparently came from the same nest.

10. Small-winged Lasius flavus and L. niger.—Females of *Lasius niger* and *L. flavus* are sometimes found with small wings, otherwise perfectly formed, but barely one-half the normal size. In Oxfordshire, August 21st, 1898, I found a ♀ of *L. flavus* on a road, with very small wings. Next day I found another near the same place. There were several normal ♀s about, as a nest had swarmed close by. A few days later, August 28th, I found some similar ♀s of *L. niger* in a nest, close to where I had found the *L. flavus* ♀s. On July 17th, 1900, I again found five short-winged *L. flavus* ♀s in a nest in the same neighbourhood, and six more on August 7th, 1901, on a road. I threw some of these into the air, but they dropped straight down, and seemed unable to fly. Again on July 19th, 1901, I found four short-winged *L. niger*

♀s in a nest in the same neighbourhood. I have most of these abnormal ♀s in my collection.

11. Peculiarities re swarming.—It seems that it occasionally happens that all the winged ♀s do not always leave the nest when swarming, as some are found in nests long after the usual time for swarming. On September 14th, 1908, I found a large number of *L. fuliginosus* ☿s and winged ♀s on a bank close to their nest. There were no ♂s among them. This species usually swarms at the end of May or beginning of June. On October 13th, 1909, there were numerous ♂s in a nest of *L. flavus*, and they certainly never left the nest before the cold weather began. From observations on nests kept in captivity, it seems possible that under such conditions there is an analogous proceeding to the killing of drones by worker bees. In all the following cases the ants were allowed to wander over a large table, so that the ♂s and ♀s were not prevented from flying off. In August, 1896, the ☿s of a nest of *L. niger* that had just accepted a new queen, killed a solitary winged ♀ that had been in the nest for some time. On August 6th, 1897, ten winged ♀s in a nest of *L. flavus* that had just received a new queen, were killed, their wings having been previously removed. By August 26th, 1898, twenty-eight winged ♀s and four ♂s that had hatched in a nest of *L. niger* with a queen, were all killed and the wingless bodies thrown out of the nest. On August 26th, 1895, in a nest of *L. niger* containing a queen, one winged ♀ and six ♂s were killed; and two winged ♀s and one ♂ in another nest of *L. niger* in August, 1896, were killed. In this last case, some days before they were killed, the ♀s had become very excited, had removed their wings, and begun to carry pupæ about the nest. In another nest of *L. niger* the young ♀s and ♂s had been gradually destroyed, the last pair being killed on August 29th, 1898. On September 17th, 1908, three ♀s that had hatched in a nest of *L. niger* (that had just received a new queen) were stripped of their wings and killed. Lastly, in October, 1909, a solitary ♀ that had come to maturity in a nest of *M. laevinodis*, was killed, having first lost her wings.

The Lepidoptera of the Tirol—The Sarnthal.

By J. W. TUTT, F.E.S.

Surely enough, as we surmounted the Brenner Pass on the morning of August 5th, the clouds broke, and by the time we had reached Botzen we found it fine, almost brilliant, the sun shining, and, as a good baking was nothing more than we then desired, we walked up into the Eggenthal, but the entrance to this lovely valley in the porphyry mountains is narrow, and the afternoon being largely spent, little was to be done there, and we believe that *Parnassius apollo*, *Dryas paphia*, *Argynnis adippe*, *Brenthis daphne*, *Coenonympha arcania*, *Pararge megaera*, *Leptosia sinapis*, *Hipparchia hermione*, *Libythea celtis*, and *Anthrocera ephialtes*, of lovely steel-blue colour and white spots, were all the species observed.

The next morning was bright, hot and sunny, and so we made for the Sarnthal, and certainly August 6th and 7th were a real pleasure, yet we only explored a short distance up the valley, only knocked as it were at the door of the promised land. How the sun did pour down into that valley, how the heat was reflected from the steep